Feature

HUBBLE'S Upgrades Yield Sharp Views of Mars/Other New Data

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Three months after an orbital house call by astronauts, new instruments aboard the Hubble Space Telescope are helping astronomers probe the universe in greater detail than ever before. "We're extremely excited about the quality and precision of the images from Hubble," said Wes Huntress, associate administrator for Space Science. "Following check-out of the instruments, Hubble will return to full science operations, and we can expect a continuing flow of new and exciting discoveries."

Hubble status

Project officials are encouraged that a problem detected earlier with one of the cameras on the infrared instrument has shown some improvement. The problem stems from the unexpected movement of the dewar—an insulated vessel containing solid nitrogen at extremely cold temperatures. After launch, the nitrogen expanded more than expected as it warmed, moving the dewar into contact with another surface in the mechanism and pushing one of the cameras out of its range of focus. The camera has moved back about one-third of the distance required to be within reach of the instrument's internal focusing mechanism. This is because the dewar is "relaxing" toward its normal state, as pressure caused by the expansion of the nitrogen is reduced. The ice keeps the sensitive infrared detector cooled. Project officials also are considering how to deal with unexpected, excessive coolant loss.

"We are anticipating a shorter lifetime for the instrument, but we don't know how much shorter," said Goddard Space Flight Center's (GSFC) Hubble Project Scientist, David Leckrone. "We are taking steps to work around the problem, and will increase the percentage of time this instrument will be used."

NASA officials also report that other upgrades to Hubble are performing well, including the newly installed solid state recorder, fine guidance sensor, and solar array drive electronics. The solid state recorder has significantly improved data storage and playback, and the new fine guidance sensor is by far the best of the three on Hubble.

Best Mars views

Following the second servicing mission, the sharpest-ever views of the planet Mars taken Hubble's Wide Field Planetary Camera-2 (WFPC2) clearly show clouds, polar caps, and other bright and dark markings known to astronomers for more than a century. The images were taken just before Mars opposition—when the red planet comes closest to the Earth this year (about 60 million miles or 100 million km). Each picture element (pixel) in WFPC2's Planetary Camera's image spans 13 miles (22 km) on the Martian surface.

These images show the planet during the transition between spring and summer in the northern hemisphere (summer solstice). The annual north-polar, carbon-dioxide frost (dry ice) cap is rapidly subliming, revealing the much smaller permanent water-ice cap, along with a few nearby detached regions of surface frost.

Hubble is being used to monitor dust storm activity to support the Mars Pathfinder and Mars Global Surveyor Orbiter Missions, which are currently en route to Mars. Hubble's "weather report" from these images, is invaluable for Mars Pathfinder, which is scheduled for a July 4 landing. These images show no evidence for large-scale dust storm activity, which plagued a previous Mars mission in the early 1970s.

Recent observations

The initial results following the servicing demonstrate the ability of the new instruments to fulfill astronomers' science goals with the telescope. Among Hubble's recent observations are:

- *Jets and Gaseous DiskAround the Egg Nebula*—a new infrared instrument peered deep into the dust-obscured central region around a dying star embedded in the Egg nebula, a cloud of dust and gas 3,000 light years from Earth. The new images provide a clear view of a twin pair of narrow bullet-shaped "jets" of gas and dust blasted into space. The instrument, called the Near Infrared Camera and Multi-Object Spectrometer, also revealed an unusual scalloped edge along a doughnut-shaped molecular hydrogen cloud in the nebula.

Because we can now see these 'missing pieces' in infrared and visible light, we have a more complete view of the dynamic and complicated structure of the star," said Rodger Thompson of the University of Arizona-Tucson, the principal investigator for the infrared instrument. "It also allows us to see a 'fossil record' of the star's late evolutionary stages."

- *Unveiling Violent Star Birth in the Orion Nebula*—the new infrared instrument penetrated the shroud of dust along the back wall of the Orion nebula, located in the "sword" of the constellation Orion. Data revealed what can happen to a stellar neighborhood when massive young stars begin to violently eject material into the surrounding molecular cloud. Although ground-based infrared cameras have previously observed this hidden region known as OMC-1, the Hubble's new instrument provides the most detailed look yet at the heart of this giant molecular cloud. Hubble reveals a surprising array of complex structures, including clumps, bubbles, and knots of material. Most remarkable are "bullets" composed of molecular hydrogen, the fastest of which travels at more than one million mph (500 km/s). These bullets are colliding with slower-moving material, creating bow shocks, like a speedboat racing across water.
- *Monster Black Hole in Galaxy M84*—in a single exposure, a new powerful instrument called the Space Telescope Imaging Spectrograph discovered a black hole at least 300 million times the mass of the Sun. The spectrograph made a precise observation along a narrow slit across the center of galaxy M84, located 50 million light-years away. This allowed the instrument to measure the increasing velocity of a disk of gas orbiting the black hole. To scientists, this represents the signature of a black hole, among the most direct evidence obtained to date. Due to their nature, it's impossible to directly photograph black holes. Scientists must instead look for clues to show the effects of black holes on surrounding dust, gas and stars.

"Hubble proved the existence of supermassive black holes three years ago," said Bruce Woodgate, the principal investigator at GSFC for the new spectrograph. "With this new instrument, we can do it 40 times faster than we used to."

- *Composition and Structure of the Ring Around Supernova 1987A* —the new spectrograph also provides an unprecedented look at a unique and complex structure in the universe; a light-year-wide ring of glowing gas around Supernova 1987A, the closest supernova explosion in 400 years. The spectrograph dissects the ring's light to tell scientists which elements are in the ring and helps paint a picture of the physics and stellar processes which created the ring. This gives astronomers better insight into how stars evolve and become a supernova, and into the origin of the chemical elements created in these massive explosions.

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